Filed: 7/30/01

CERTIFIED FOR PUBLICATION

IN THE COURT OF APPEAL OF THE STATE OF CALIFORNIA

FIRST APPELLATE DISTRICT

DIVISION THREE

THE PEOPLE,
 	
        Plaintiff and Respondent,
 	
v.
 	
LAWRENCE ADAM REEVES,
 	
        Defendant and Appellant.
	A078462
	
	(Marin County
	 Super. Ct. No. SC61886)

This appeal raises three challenges to the admissibility of statistical calculations based on DNA evidence. We conclude none of them has merit and that the procedures at issue have gained general acceptance in the scientific community.

A jury convicted appellant of several burglaries and sexual offenses committed against multiple victims during a nine-month period, and he was sentenced to 77 years in prison. With respect to two of the sex crimes charged, the jury heard forensic DNA evidence identifying appellant as the perpetrator. He challenges the admission of this evidence on appeal, claiming it should have been excluded pursuant to *People v. Kelly* (1976) 17 Cal.3d 24 (*Kelly*). Specifically, appellant argues: (1) the formula used by the California Department of Justice (DOJ) to calculate the statistical significance of DNA matches is not generally accepted in the scientific community because it fails to consider laboratory error rates; (2) the DOJ's formula for calculating statistical significance of DNA matches determined by polymerase chain reaction (PCR) analysis is not generally accepted in the scientific community; and (3) the DOJ's "fixed-bin" technique for determining the statistical probability of a DNA match violates correct scientific

procedures because the bins are too small.[1] Appellant claims the erroneous admission of DNA evidence deprived him of a fair trial and requires reversal.

Appellant also raises several "non-DNA" claims. He contends the evidence was insufficient to prove sexual battery in one charge and attempted robbery in another. He also claims the trial court erred in failing to instruct the jury sua sponte on lesser included offenses, with respect to the robbery convictions, and in calculating his sentence.

We conclude the trial court properly admitted the DNA evidence. However, the judgment must be modified to remedy minor instructional and sentencing errors.

BACKGROUND

I.   The Crimes

A.   Sexual Assaults

1.   Linda H.

One night in November 1993, 47-year-old Linda H. was home alone. She was not feeling well and went to bed in her clothes. She awoke around 5:30 a.m. to find an intruder leaning over her in the dark. He was holding a crowbar in one hand and pulling her bedside phone off the hook. He said, "Don't make a sound, don't look at my face, I don't want to have to hurt you, ma'am." He told Linda to roll over and then pulled her arm up behind her back so she could not move. He asked where Linda kept her jewelry, and she told him it was in the bathroom.

The intruder did not get up but began touching Linda's buttocks and thighs over her clothes. When Linda repeated that her jewelry was in the bathroom, the man said, "come here" and pulled her face toward his unzipped crotch. "This is what I want," he said, and pushed Linda's head onto his erect penis. Linda said "oh no," but the man

---

[1]   In his opening brief, appellant also challenged the DNA evidence on the ground that the DOJ's formula for determining the significance of a DNA match ascertained by restriction fragment length polymorphism (RFLP) analysis is not generally accepted because it does not account for statistical difficulties created by population subgroups. However, while this appeal was pending, the California Supreme Court expressly rejected the same argument in *People v. Soto* (1999) 21 Cal.4th 512 (*Soto*). Accordingly, appellant has abandoned this claim, and we do not address it.

shook the crowbar in a threatening way. He thrust his penis in and out of her mouth, still flexing and shaking the weapon. At one point, the man reached under Linda's clothes and touched her breast. When she pushed his hand away, the intruder turned her over, pulled down her pants and underwear. He touched his penis to her genitals and attempted to enter her. To prevent this, Linda grabbed the man's penis and masturbated him until he ejaculated into her hand.

Still holding the crowbar, the intruder forced Linda into the shower. He apologized, stating that God would punish him. He told Linda to wash her genital area thoroughly, with a lot of soap, and then told her to "stay there" while he walked toward the bedroom. After about 15 minutes, Linda ventured out of the shower and learned the intruder was gone. She later discovered her purse was missing from the house.

Linda described her attacker as Caucasian, between five feet seven and five feet nine inches tall, with a narrow waist and hips, strong hands and stubby fingers. Linda viewed two police lineups, in March 1994 and April 1996. At the first, held before appellant was a suspect, Linda felt "75 percent sure" one of the men was her attacker. At the second lineup, which included appellant, Linda noted that appellant and another suspect bore a strong physical resemblance to her attacker, but she could not positively identify either.

Police officers removed the stained bottom sheet from Linda's bed. Forensic investigators determined the stain was seminal fluid, and, upon microscopic examination, they found sperm. The semen came from a donor with Type O blood plus a secretor, and with a PGM enzyme of type 1 plus, 1 minus. Appellant matched all these characteristics. Police also recovered two pubic hairs from the sheet. One appeared to be the victim's, and the other resembled appellant's pubic hair.

### 2.	Carol B.

Carol B., a 45-year-old woman who lived alone, went to sleep at 11:00 p.m. on December 7, 1993. She woke to find an intruder standing by her bed. When she screamed, the intruder immediately covered her mouth and told her, "Don't look at me,

don't scream. I won't hurt you if you don't scream." Carol saw the man was holding a knife. She looked away and noticed her clock said it was 5:32 a.m. The intruder began fumbling with Carol's mini-blinds, eventually opening them and the bedroom window. He asked how old Carol was. She told him and then lied that she was very sick from cervical cancer, hoping that would scare him away. He replied, "Do you think you're the only person in this room who's sick?" Carol then heard clothes rustling, and when she turned she saw that the man's pants were unzipped and his penis exposed. He told her to put her hand on it and "move it up and down," which Carol reluctantly did. The intruder made Carol take off her shirt and forced her to orally copulate him. He ordered her not to spit anything out, and said "if you spit it out, it's going to be all over for you." When the man eventually ejaculated, Carol surreptitiously spit as much as she could into her hand and then wiped it onto her pillowcase. The man quickly dressed, closed the window and blinds, and ordered Carol into the shower. He told her to stay there while he looked around. When Carol emerged from the shower, she found the kitchen phone unplugged but was able to call police from a bedroom phone. She suffered a sore, bruised mouth from the attack, and she later discovered her purse had been taken.

Carol only saw her attacker briefly. She described him as Caucasian, in his late twenties, around five feet eight or nine inches tall, weighing 140 to 150 pounds. He was physically fit but not large, and he had rough hands with stubby fingers. Carol attended both the 1994 and 1996 police lineups. She put question marks next to three of the suspects in the first lineup and one in the second lineup, but she could not positively identify anyone as her assailant.

The police discovered three latent fingerprints from Carol's china cabinet. One of these, a partial print, matched appellant's left index finger. Police investigators also examined Carol's stained pillowcase. Because they could not readily determine whether the stains contained sperm, investigators sent the pillowcase to the DOJ's DNA laboratory in Berkeley, California. This laboratory has the technical capacity to separate sperm cells from saliva and other cellular debris.

4

3.   Janice B.

One night in February 1994, 56-year-old Janice B. went to sleep alone and was awakened by a man who was holding her shoulder and telling her to stay quiet. The man had a flashlight, and he spent some time searching the room for a gun or security alarm. When the intruder came back to Janice and unzipped his pants, Janice said "Oh dear God, please be with me now." The man immediately zipped up his pants and asked Janice if she believed in God. She said she did and asked if he did too. When the man said "yes," Janice asked him what he was doing there. He told her he had a lot of problems. Janice tried to talk with the man about his problems while they each smoked a cigarette. Janice told the man he seemed too smart to be ruining his life, and the man said she seemed "like a neat person." But after they smoked, the intruder's attitude changed. He began barking instructions and said he would hurt Janice if she did not do what he said. He told her to bring him her best pair of silky underwear. When she did so, the man unzipped his pants and masturbated himself with the panties. He told Janice to pull up her nightgown so he could look at her, and after a while he handed Janice the panties and said, "[y]ou know what to do." She then masturbated him with the underwear. After he ejaculated, the intruder pulled down the bedding and scrubbed Janice's bed with the panties. He then ordered Janice into the shower and told her to stay there while he looked through the house. At one point, he came back into the bathroom, reminded her that he knew who she was and where she lived, and threatened to come back if she told anyone about the incident. When she heard the intruder leave, Janice ran to the manager's apartment and called the police. Along with the underwear her attacker had used, Janice noticed that some of her jewelry was missing, as was a decorative turquoise knife her son had made for her. Eighty dollars had been taken from her purse.

Janice described her attacker as Caucasian, well-spoken, around 25 years old, and about five feet eight or nine inches. She also viewed both the 1994 and 1996 police lineups, but could make no identification at either.

The police obtained one fingerprint lift from Janice's apartment, but they could not make an identification based upon it. When investigators analyzed Janice's sheet,

they found some pubic hairs, which they determined were consistent with appellant's. They recovered no semen from the sheet.

4. Debra E.

In June 1994, Debra E. lived with her roommate in a two-bedroom apartment. She was jerked awake one night by a man who was lying on top of her back and grabbing her hair and shoulder. The man said "Don't scream and I won't hurt you," but Debra screamed as loud as she could. The intruder said, "Shut up or I'll shoot you" and put something to her neck, but Debra discovered it was just the man's finger. They struggled, and the man began to choke Debra. After she promised to be quiet and do what he wanted, the man slammed her face into the carpet and tied her wrists together with rope. Debra asked if he wanted to have sex with her, hoping he would do this instead of killing her, but the intruder said no, that was not what he wanted. He pushed her face into the carpet. When Debra struggled to get free, the intruder slammed his knee into her ribcage and struck her hard on the side of the head. Debra began screaming again, despite the intruder's threat to use a knife on her and the extremely hard blows he dealt to both sides of her face and head. The assault was finally interrupted by police sirens. (Debra's roommate, awakened by the screams, had called police from a pay phone outside, after discovering the phone in their apartment was dead.) The intruder ran out a sliding glass door. He was chased by police but evaded capture. Debra suffered multiple injuries from the assault, including trauma to her head, face, back and neck. Some things had been moved around in the apartment, and Debra's roommate later discovered that her great grandmother's engagement ring was missing from her jewelry box and a gold necklace she had left on the floor was gone.

Debra believed her attacker was Caucasian, about five feet seven to nine inches tall, and very strong. He had neck-length brown hair and rough hands that smelled like cigarettes. At the April 1996 lineup, Debra picked out appellant; however, she admitted she chose him based on having seen his photograph in the newspaper and had no independent recollection of his face.

The police recovered nylon cable, a plastic flex tie and a flashlight from Debra's bedroom. A latent fingerprint lifted from one of the flashlight's batteries matched appellant's right index finger. Officers on the scene also found an abandoned bicycle, a discarded maroon sweatshirt, apparently worn by the intruder, and a screwdriver that had been used to pry open the sliding glass door of the apartment. Etched onto the screwdriver was the name "Harro Clifton."

B.   Burglaries

Ed Willis returned home from an overnight trip in October 1993 to find his home had been burglarized. Someone had pried open a sliding glass door and stolen, among other things, his collections of coins, knives and firearms.

On December 7, 1993, someone broke into Paul Clark's apartment and stole a guitar and various pieces of jewelry.

In January 1994, Nigel Rees found his townhouse had been burglarized when he was away overnight. The intruder pried open a sliding door and stole cameras, clothing and some jewelry.

On May 12, 1994, the owner of Handlogger's lumber business, Tim Mahoney, discovered his office had been broken into. The burglar took a rifle and a custom-built bicycle. Mahoney later identified the bicycle seized outside Debra E.'s apartment as his stolen property.

Kristine Bedford returned home from work one evening in June 1994 and found her house had been broken into through a sliding glass door. Missing were some jewelry, camera equipment, a case of silverware and a leather jacket.

Dorothy Castle's townhouse was burglarized on June 25, 1994, while she was asleep. The burglar stole cash from her purse, a box of silverware, jewelry and some bonds and stock certificates.

Following up on the "Harro Clifton" screwdriver found at the Debra E. crime scene, police officers began investigating this individual. They learned Clifton owned a warehouse in connection with his work as an electrical contractor. He moved much of

his personal property into this warehouse in 1993, when he separated from his wife. Clifton shared the warehouse space with three other men, who also ran businesses out of the warehouse. These men and their partners had keys to the building, as did Clifton's brother, sister and receptionist. Many people, including appellant, had access to the building.

Clifton had known appellant since they were children. In the fall of 1993, appellant asked Clifton if he could store some things in the warehouse. Appellant also slept at the warehouse sometimes, though Clifton discouraged it. Generally, appellant slept in an outdoor area, but he kept his things at the warehouse. In January 1994, Clifton moved to San Francisco and gave appellant a key to the warehouse.

When police first visited Clifton's warehouse, which was about a quarter mile from Debra E.'s apartment, they noticed several flex ties like the one found at the Debra E. crime scene. In a search of the warehouse, police discovered: a semiautomatic pistol; a manual for an Intertec 9 semiautomatic weapon, which was identified by Ed Willis; a chess set with velvet interior and magnetic pieces, later identified by Linda H. and her two daughters; jewelry and a decorated turquoise knife, identified by Janice H.; a silverware set, identified by Dorothy Castle; a watch and pin, identified by Nigel Rees; a Taylor guitar, identified by Paul Clark; inside the guitar case, three items of jewelry, identified by Kristine Bedford; and additional jewelry and camera equipment taken from Bedford's home.

II. The DNA Evidence

The DOJ laboratory tested semen recovered from the Linda H. and Carol B. crime scenes using the two basic methods of DNA analysis: restriction fragment length polymorphism (RFLP) and polymerase chain reaction (PCR). Appellant's DNA profile (determined from a blood sample) matched the DNA from semen at both crime scenes at every site tested.

In the Linda H. case, PCR testing of the types "DQ-alpha" and "DS180" showed a match for appellant, and caused the DOJ to exclude another man who was first

considered a suspect. The DOJ also found a match between appellant's DNA and semen from the bed sheet at 10 different sites, or "loci," using RFLP analysis. Criminalist Gary Sims compared the results at six of the well known loci to DNA population databases and, using a statistical formula called the product rule, found that the probability such a match could occur at random was very small.[2] He determined the DNA profile would occur in only 1 in 54 billion Caucasians, 1 in 170 billion African-Americans, and 1 in 180 billion Hispanics. Since there are only six billion people on earth, this six-loci profile is extremely rare.

Semen extracted from Carol B.'s pillowcase was also examined. A criminalist working under Sims's supervision found a four-loci match between appellant's DNA and DNA from the evidence sample using RFLP analysis. The probability of this result occurring at random was 1 in 7.7 million for Caucasians, 1 in 26 million for African-Americans, and 1 in 17 million for Hispanics. PCR testing of the DQ-alpha and polymarker types also showed a match between the DNA in appellant's blood and in semen from the crime scene. The probability of this result, calculated by the product rule, was 1 in 500,000 Caucasians, 1 in 11 million African-Americans, and 1 in 260,000 Hispanics.

Appellant made a pretrial motion to exclude all DNA evidence on the ground that it did not satisfy the criteria for admissibility under *People v. Kelly, supra,* 17 Cal.3d 24.

A.   Overview Of DNA Analysis

Previous opinions of this court (*People v. Barney* (1992) 8 Cal.App.4th 798 (*Barney*)) and the Supreme Court (*People v. Venegas* (1998) 18 Cal.4th 47 (*Venegas*)) have discussed in some detail the science of forensic DNA analysis. We summarize the

---

[2]   The DNA matched at 10 loci, but the DOJ included only six in its statistical analysis because these six sites had been extensively studied and found to be appropriately independent of each other, and researchers had compiled large population frequency databases for them. Sims testified that more recent population studies have confirmed the independence of some of the loci DOJ did not consider in its statistical calculations. Under the product rule, consideration of matches at these additional loci would make the probability of a random match astronomically small.

important principles again here, because the bulk of appellant's claims concern the scientific validity of the DNA evidence linking him with the Linda H. and Carol B. sexual assaults.

DNA is the genetic material found in the nucleus of virtually all human cells except red blood cells. It is organized into 23 pairs of chromosomes, one chromosome in each pair being inherited from the mother and one from the father. (National Research Council, The Evaluation of Forensic DNA Evidence (1996) pp. 60-61 (hereafter 1996 NRC Rep.).) "A chromosome is a long DNA molecule in the shape of a spiral staircase. [Citation.] 'It consists of two parallel spiral sides (i.e., a double helix) composed of repeated sequences of phosphate and sugar. The two sides are connected by a series of rungs, which constitute the steps in the staircase. Each rung consists of a pair of chemical components called bases. There are four types of bases—adenine (A), cytosine (C), guanine (G), and thymine (T). A will pair only with T, and C will pair only with G.' [Citation.] There are over 3 billion base pairs in the 46 chromosomes of a single human cell." (*Venegas, supra,* 18 Cal.4th at pp. 58-59.)

"In most portions of DNA, the sequence of base pairs is the same for everyone. Those portions are responsible for shared traits such as arms and legs. In certain regions, however, the sequence of base pairs varies from person to person, resulting in individual traits. A region—or locus—that is variable is said to be polymorphic. In some polymorphic loci, at fragments called alleles, short sequences of base pairs repeat for varying numbers of times. These are called variable number of tandem repeat (VNTR) sequences." (*Barney*, *supra*, 8 Cal.App.4th at p. 806.) Forensic scientists have developed two procedures to identify individuals through variations in the base-pair sequences at polymorphic DNA loci: RFLP and PCR. (*Venegas, supra,* 18 Cal.4th at p. 58, fn. 6.)

1.   RFLP Processing And Matching Procedures

RFLP analysis focuses on the highly variable VNTR loci. The variability of these regions "is what makes DNA analysis possible. In effect, the lengths of sets of multiple

(usually eight) polymorphic fragments (or VNTR alleles) obtained from a suspect's DNA and from crime scene samples are compared to see if any sets match, and a match is accorded statistical significance." (*Barney*, *supra*, 8 Cal.App.4th at p. 806.)

DNA from a sample and from a suspect must be processed to allow comparison. First, DNA is extracted from bodily material. (*Barney*, *supra*, 8 Cal.App.4th at p. 806.) Second, the "extracted DNA is 'cut' into thousands of fragments at specific points by application of restriction enzymes. The restriction enzymes act as 'chemical scissors' in that they sever the DNA at targeted base-pair sites." (*Ibid.*) Third, in a process called electrophoresis, the DNA fragments are separated according to their base-pair size. "The various sample fragments being tested are placed in separate lanes on one end of a gel slab and an electrical current is applied, causing the fragments to move across the gel. Shorter fragments move farther than longer fragments. Thus, at the completion of electrophoresis, the sample fragments are arrayed across the gel according to size. [¶] In addition to the sample fragments, other fragments called size markers, which have known base-pair lengths, are placed in separate lanes on the gel in order to facilitate measurement of the sample fragments." (*Id.* at pp. 806-807.) Fourth, through a process called "Southern transfer," the DNA fragments are denatured and wicked from the gel onto a nylon membrane. (*Id.* at p. 807.) The fifth and sixth steps allow the DNA fragments to be visualized on X-ray film. Through hybridization, radioactive single-strand DNA probes are applied to the nylon membrane, where they seek out and bind themselves to denatured DNA fragments that have complementary base sequences.[3] (*Venegas, supra*, 18 Cal.4th at p. 61.) Then, when the membrane is washed and exposed to X-ray film, a pattern of bands appears depicting DNA fragments at each locus probed. (*Id.* at pp. 61-62.) "The location of a band on the X-ray film indicates the distance a fragment traveled as a result of electrophoresis, and hence the length of the fragment.

---

[3]   The denaturing process in step four leaves only single-stranded DNA on the membrane. Thus, "a probe with the sequence AGCT would bind with all fragments containing the sequence TCGA." (*Venegas, supra*, 18 Cal.4th at p. 61, fn. 14.)

The size-marker fragments also appear on the films, enabling measurement of the base-pair lengths of the sample fragments. [¶] The end result of the processing substeps is a picture of a person's DNA pattern (which may be produced by overlaying the four X-ray films)." (*Barney,* at p. 808.) The X-ray film is called an autoradiograph, or autorad. (*Id.* at p. 807.)

Next, scientists compare the autorads to see if the suspect's DNA pattern matches that produced by DNA from the evidence sample. "First, the patterns are visually evaluated (i.e., 'eyeballed') to determine whether there is a likely match. Most exclusions will be obvious, since the patterns will be noticeably different. If there is not an obvious exclusion, the bands in the patterns are subjected to computer-assisted analysis to determine the length of the represented DNA fragments as measured in base-pair units. The measurements are taken by comparing the bands for the sample fragments with the bands for the size-marker fragments of known base-pair lengths." (*Barney, supra*, 8 Cal.App.4th at p. 808.)

"Because of inherent limitations in the DNA processing system, it is not possible to obtain exact base-pair measurements of the sample DNA fragments. For that reason, forensic laboratories have developed DNA match criteria based on the variations they have experienced in repeated measurements of DNA from the same source. Those criteria determine the 'match window'—or range of sizes—constructed around each band for purposes of declaring a 'match.' For example, under the FBI's match criterion of plus or minus 2.5 percent, the window around a band that measures 1,000 base pairs is from 975 to 1,025 base pairs. If the window of either band, or a single band, on one sample fails to overlap the window of the corresponding band on another sample, there is an exclusion of any match between the samples. If the windows of both bands, or of the single bands, of each sample overlap, there is a match at the locus disclosed by that probe." (*Venegas, supra*, 18 Cal.4th at pp. 62-63.) The window surrounding each individual band is called an "uncertainty window," and the window that results from the combination of two bands that overlap is called a "match window." (1996 NRC Rep., *supra,* at pp. 19-20.) Although some conditions adverse to reliability may make match

results inconclusive at a given locus, such a determination "does not invalidate matches at other loci." (*Venegas,* at pp. 62-63.)[4]

If the bands at any locus do not match, the suspect is excluded as a possible donor of the sample DNA. However, "if all of the suspect's fragment lengths are the same as the crime scene fragment lengths within the margin of error—i.e., if the band patterns produced by the processing step are identical—a match is declared." (*Barney, supra*, 8 Cal.App.4th at p. 809.)

2. PCR Processing And Matching Procedures

PCR is a molecular biology technique that copies or amplifies small pieces of DNA by a process similar to DNA's own self-replicating properties. (*People v. Morganti* (1996) 43 Cal.App.4th 643, 662 (*Morganti*); 1996 NRC Rep., *supra,* at p. 69.) It has been likened to a "genetic photocopy machine" (*U. S. v. Lowe* (1996) 954 F.Supp. 401, 409), and is often employed when the DNA sample available is too small or degraded to produce good results using RFLP. (*Morganti,* at p. 662.)

PCR forensic analysis involves three steps. First, DNA is extracted from cells in the sample. Second, select regions of the DNA are amplified. Scientists have identified these regions, also referred to as genes or genetic markers, as areas that exhibit great genetic variation among the population. One widely used marker is the DQ-alpha gene. (1996 NRC Rep., *supra*, at p. 23.) On average, only about 7 percent of the population shares the same DQ-alpha type. (*Ibid.*) Like DQ-alpha, the D1S80 locus is used in PCR testing because it contains several alleles and exhibits great variation.[5] (*Id*. at p. 72.) Polymarker analysis, which amplifies several loci simultaneously, has also been validated for use in PCR testing. (*Ibid.*) After amplification, in the third and final step of PCR

---

4 Here, as in *Venegas*, the DOJ reported inconclusive results at one of the five loci probed in the Carol B. case. (See *Venegas, supra*, 18 Cal.4th at p. 63, fn. 15.) Accordingly, the DOJ declared a match and calculated its statistical significance based only on the four determinative loci.

5 The word "allele" generally refers to alternative forms of a gene. (*Venegas, supra,* 18 Cal.4th at p. 59, fn. 10; 1996 NRC Rep., *supra,* at pp. 14, 214.)

analysis the amplified gene is "typed," through the use of DNA probes, to identify the specific alleles it contains. (*Morganti, supra*, 43 Cal.App.4th at p. 662.) If the DNA profile thus constructed differs in any way between the suspect and the sample, the suspect is excluded. But if the profiles match, the analyst must next determine how common the profile is in the population.

3.   Determining Statistical Significance Of A Match

Procedures for determining the statistical significance of a match vary depending on whether the match derives from RFLP or PCR testing. Most PCR-based procedures allow alleles to be identified, and compared, as discrete entities; therefore, PCR usually does not entail the same measurement uncertainties as are encountered in RFLP analysis of VNTR fragments. (1996 NRC Rep., *supra,* at p. 70.) Essentially, this means that an additional step, called "binning," is required in an RFLP statistical analysis.

a.   RFLP Binning Procedures

Once a match of a given base-pair size has been found at a certain locus, the next question is how frequently that size occurs at that locus in the general population. In other words, how commonly are DNA bands of a certain size found in this region? "This is accomplished by assigning each band to a category comprising a definite range of base-pair lengths—called a bin—and then determining how often bands within that bin appear in a data base composed of persons of a given race." (*Barney, supra*, 8 Cal.App.4th at p. 809.)

There are two types of bins: floating and fixed. "A floating bin, constructed for each forensic comparison, is a range of sizes at least as large as the match window, centered on the measured size of the evidentiary band in question. The evidentiary band's frequency, i.e., the probability of its appearing in the DNA profile of a randomly selected member of the population underlying the database, is calculated from the ratio of the number of bands in the bin to the total number of bands in the database for that locus." (*Venegas, supra*, 18 Cal.4th at pp. 64-65.)

14

"Fixed bins, on the other hand, compartmentalize the entire spectrum of VNTR base-pair sizes likely to appear as bands on an autorad. The spacing of the fixed-bin boundaries is somewhat uneven because, like the bands in the autorad's sizing-ladder lanes, they are derived from viral DNA that has been exactly measured. A separate fixed-bin table is compiled for each locus in each database. Each database band is entered within the bin that encompasses its base-pair size. To protect a suspect against unduly small frequencies, any bin with four or fewer bands is combined with its neighbor until each bin contains a minimum of five bands. The fixed-bin table shows not only each bin's range of sizes and number of bands, but also each bin's frequency, which is calculated from the ratio of the number of bands in the bin to the total number of bands in the table. (See 1996 NRC Rep., *supra*, [at] pp. 97, 143; Budowle et al., *Fixed-Bin Analysis for Statistical Evaluation of Continuous Distributions of Allelic Data from VNTR Loci, for Use in Forensic Comparisons* (1991) 48 Am. J. Hum. Genetics 841, 846 [citing an example in which a table of 31 bins, ranging from 0 to over 12,000 base pairs, was collapsed into a table of 23 bins].) [¶] In fixed-bin analysis, the frequency of an evidentiary band is determined by assigning it the frequency of the fixed bin into which its base-pair size falls." (*Venegas, supra*, 18 Cal.4th at p. 65.)

In view of the measurement uncertainties of RFLP, analysts include an uncertainty window around DNA bands produced by the evidence sample and the suspect's sample. Whereas the FBI uses an uncertainty window of 2.5 percent around each band (1996 NRC Rep., *supra,* at p. 19), the DOJ uses a window of plus or minus 1.8 percent. As discussed, a "match" is declared when the uncertainty windows of the evidence and suspect bands overlap. The "match window" that is then compared to population frequency tables may be defined in different ways. Based on the FBI's uncertainty window of 2.5 percent, the National Research Council (NRC) defines the match window as the evidence band's measurement with 5 percent of its value added and subtracted— for a total match window of 10 percent around the evidence band. (*Id.* at p. 20.) By contrast, the FBI defines the match window to be the window formed by the union of the 5 percent-wide evidence window and the 5 percent-wide suspect window. (*Id.* at p. 144;

see also *Venegas, supra,* 18 Cal.4th at p. 64, fn. 16.) Thus, the FBI's match window—i.e., the range of values it compares to a population frequency database—is no larger than 10 percent wide and may be smaller.[6]

Where the match window overlaps multiple fixed bins, the DOJ, like the FBI, assigns the match to the fixed bin with the highest probability. The 1996 NRC Report recommends this procedure, although a 1992 report (National Research Council, DNA Technology in Forensic Science (1992) (hereafter 1992 NRC Rep.)) recommended that the frequencies of all overlapped bins be added together. (1996 NRC Rep., *supra,* at p. 144; *Venegas, supra,* 18 Cal.4th at p. 65, fn. 18.)

b. Mathematical Calculations: The Product Rule

The final step in both RFLP and PCR analysis requires the analyst to calculate the statistical probability that the DNA profile of a person, selected at random from the relevant population, would contain the same pattern of alleles represented in the evidence sample. (*Venegas, supra,* 18 Cal.4th at p. 65.) In RFLP, bands at each locus have been assigned to fixed bins, each of which is known to contain alleles that occur at certain frequencies in population databases specific to Caucasians, African-Americans and Hispanics. Databases have also been developed to determine population frequencies of the various alleles that may be detected using PCR. (1996 NCR Rep., *supra,* at pp. 117-119.)

Once population frequencies have been determined for each locus, the analyst must calculate the probability that a person at random would have the same *combination* of matches at all loci. "The most straightforward means of making this calculation is through application of the 'product rule.' " (*Venegas, supra,* 18 Cal.4th at p. 65.) "The essence of the product rule is the multiplication of individual band probabilities to arrive at an overall probability statistic expressed as a simple fraction, such as 1 in 100,000."

---

6   The match window will be smaller than the sum of the 5 percent uncertainty windows if the windows surrounding the evidence band and the suspect band overlap to a significant degree. (See 1996 NRC Rep., *supra,* at p. 144.)

(*Id.* at p. 66.) Thus, the product rule is simply the multiplication of the frequencies found at each locus studied. The result is a probability statistic that reflects the overall frequency of the complete DNA profile. It is often quite small. (*Ibid.*)

B. The *Kelly* Hearing

The trial court in this case held a five-day evidentiary hearing pursuant to Evidence Code section 402 and *People v. Kelly*, *supra,* 17 Cal.3d 24, to determine the admissibility of DNA evidence against appellant. As a preliminary matter, the court found that the first stages of DNA analysis, i.e, "the science of typing and matching genetic factors," had gained general acceptance in the scientific community and were admissible under *Kelly*. The court therefore confined the issues at the hearing to: (1) the general acceptance of statistical analyses used to determine the significance of matching DNA profiles; and (2) the propriety of testing methods employed in this case.

1. Prosecution Expert Testimony

a. Julian Adams

Dr. Julian Adams, a population geneticist at the University of Michigan, addressed the DOJ's RFLP statistical calculations and the RFLP measuring and matching process in general. Adams testified that the NRC includes some of the most respected scientists in the country and, along with the National Academy of Sciences, is responsible for advising the government on scientific issues. He was familiar with the NRC's 1992 and 1996 Reports on DNA evidence, and he opined that the procedures outlined in the 1996 Report for the statistical evaluation of RFLP matches are generally accepted within the scientific community.

In Adams' opinion, it is scientifically appropriate to use the product rule to determine the statistical significance of an RFLP match, even though the rule was criticized in the past for failing to account adequately for the possibility of substructuring

17

within populations.**7** Some scientists have argued the FBI's three population databases are too homogenous and can produce misleading frequency data for such subgroups. (See 1996 NCR Rep., *supra,* at pp. 28, 99-104.) To address this concern, authors of the 1992 NRC Report developed mathematical modifications of the product rule called the "ceiling principle" and "interim ceiling principle," which essentially placed lower limits on the frequency values that could be reported. (*Id.* at p. 35.) However, in 1996 the NRC concluded that sufficient data had accumulated to show that *neither* ceiling principle is necessary, and the 1996 NCR Report therefore endorsed use of the unmodified product rule. (*Id.* at pp. 35, 38; see also *Soto, supra,* 21 Cal.4th 512, 540.)

On cross-examination, the defense questioned whether the DOJ's fixed-binning procedures could lead to statistical errors, because some of the fixed bins were smaller

Adams was "very impressed" with the DOJ laboratory's procedures and attention to detail, and he thought there was not a better DNA testing lab in the country. In this case, the DOJ used scientific procedures that were correct and even more conservative than those recommended by the NRC. The defense attempted to cross-examine Adams about the rate of "false-positive" errors in DNA laboratories across the country; however, the trial court sustained relevance objections to most of this questioning. Adams agreed with the 1996 NRC Report's conclusion that it is not appropriate to factor an "average error rate" into DNA profile frequency calculations, because accurate lab error rates are too difficult to determine and laboratories may vary widely in their proficiencies. Moreover, all laboratories now undergo extensive proficiency testing, and procedures to protect against error have greatly improved over past years. The proper way to address any continuing concern over laboratory errors, Adams opined, is to split samples and allow testing by different laboratories.

On cross-examination, the defense questioned whether the DOJ's fixed-binning procedures could lead to statistical errors, because some of the fixed bins were smaller

---

7   "Substructuring" refers to the problem that can theoretically arise from the presence of subgroups within a population who share some similar genetic traits. For example, within the Caucasian database, people of Swiss ancestry may tend to mate with other Swiss descendants. This endogamous (as contrasted with random) mating can result in the creation of an ethnic subgroup that, over time, develops substantially different genetic frequencies than are found when the population is considered as a whole. (See *Barney*, 8 Cal.App.4th at pp. 814-815.)

than the potential match windows. The defense argued the use of such undersized bins would lead to improperly low estimates of population frequencies. Adams was not familiar with the article that formed the basis of this argument (Fung, *10% or 5% Match Window in DNA Profiling* (1996) 78 Forensic Science Internat. 111 (hereafter Fung)), but he thought any problem with small bins would be resolved by the FBI (and DOJ) procedure of combining fixed bins that have very rare frequencies.

b.   Charlotte Word

Dr. Charlotte Word, a molecular biologist at the private laboratory Cellmark Diagnostics in Maryland, testified about her review of the DOJ laboratory's testing procedures, primarily in regard to PCR. Word discussed how PCR testing is done in general and the particular results of PCR analysis in the Carol B. case, which found matching alleles at seven separate loci. She explained that the DOJ calculated the significance of this match by looking up the population frequencies of each of the seven alleles and then multiplying them together pursuant to the product rule.[8]

Word confirmed that the product rule is generally used throughout the forensic community to assess the statistical significance of PCR-based tests, and she cited the NRC's conclusion that the statistical preconditions for use of the product rule, which have been proven for RFLP, are also true for PCR. (1996 NRC Rep., *supra,* at pp. 35, 119.) These preconditions are "Hardy-Weinberg equilibrium" and "linkage equilibrium." Hardy-Weinberg equilibrium means that, at a particular genetic locus, alleles are inherited independently of each other, such that the presence of one allele is not correlated with any other allele at that locus. (*Venegas, supra,* 18 Cal.4th at pp. 66-67; 1996 NRC Rep., *supra,* at pp. 90-92.) Linkage equilibrium means that alleles at *different* genetic loci are independent, such that an allele at one locus is not correlated with the presence of a certain allele at another locus. (*Venegas,* at p. 67; 1996 NRC Rep., *supra,*

---

[8]   The defense objected that Word, a molecular biologist, was not qualified to give expert opinions about statistical calculations, but the court allowed her to testify about how the product rule worked. She was not to express an opinion, however, as to its "reliability."

at p. 106.) According to Word, studies have shown that the regions examined in the DOJ's PCR testing satisfy Hardy-Weinberg and linkage equilibrium. She knew of no published article disagreeing with application of the product rule to these PCR loci, nor of any controversy in the scientific community about use of the product rule in PCR analysis in general.

Word reviewed the RFLP and PCR testing done in this case and confirmed that the DOJ performed both in accordance with generally accepted and reliable scientific protocols. The trial court sustained relevance objections when the defense attempted to cross-examine Word about the history of laboratory errors at her facility, Cellmark. Word was not aware of any laboratory errors ever occurring in forensic DNA analysis at the DOJ lab. She observed that the laboratory is accredited by the American Society of Crime Laboratories Directors and therefore has submitted its procedures to intense scrutiny through, for example, proficiency testing and on-site inspections.

c.   Gary Sims

Gary Sims, a supervising criminalist at the DOJ laboratory, testified in general about the lab's accreditation and quality assurance protocols and also addressed the specific testing done in the Linda H. and Carol B. cases. Sims explained that most of the DOJ's testing protocols are based on procedures developed by the FBI. In RFLP analysis, the DOJ will declare a match only when the evidence and suspect bands fall within "a plus or minus 1.8 percent match window." The lab then uses the FBI's fixed bin methodology to determine population frequencies and applies the unmodified product rule to complete the statistical analysis. Sims testified that, no matter which formula was applied to determine statistical significance, an RFLP match seen across multiple loci is exceedingly rare. The DOJ also uses the unmodified product rule in PCR analysis. Sims knew of no published article criticizing the use of the product rule to calculate PCR-based statistics.

Sims stated that DNA analysts at the DOJ laboratory undergo proficiency testing twice a year. He also confirmed that evidence samples from each of the cases had been

20

split, so that they could be retested by the defense. Once again, the trial court sustained relevance objections to defense questions concerning previous laboratory errors committed at the DOJ laboratory or by Sims or other analysts who worked with him. The court reasoned that the only relevant errors were errors committed in this case.

2. Defense Expert Testimony

The defense presented only one witness at the *Kelly* hearing: Dr. Laurence Mueller, a professor of ecology and evolutionary biology at the University of California, Irvine. Mueller testified to his opinion that a controversy exists in the scientific community concerning the propriety of using the unmodified product rule in RFLP analysis. Our Supreme Court has since disagreed in *Soto, supra,* 21 Cal.4th 512,[9] and appellant has withdrawn this claim on appeal. However, we summarize Mueller's attack on the product rule insofar as it remains relevant to a PCR analysis.

First, Mueller argued that the product rule is statistically invalid due to the existence of population subgroups. Although a 1992 analysis of the FBI's DNA database concluded that the database satisfied Hardy-Weinberg and linkage equilibrium principles (Weir, *Independence of VNTR Alleles Defined as Fixed Bins* (1992) 130 Genetics 873; Weir, *Independence of VNTR Alleles Defined as Floating Bins* (1992) 51 Am. J. Human Genetics 992), Mueller asserted that a reanalysis of the data from Weir's study found compelling evidence of two-locus associations. (Slimowitz & Cohen, *Violations of the Ceiling Principle: Exact Conditions and Statistical Evidence* (1993) 53 Am. J. Human Genetics 314.) Such a finding indicates a departure from linkage equilibrium. According to Mueller, another study of the FBI's database found numerous departures from Hardy-Weinberg equilibrium at certain regions of RFLP analysis. (Geisser & Johnson, *Testing Independence of Fragment Lengths within VNTR Loci* (1993) 53 Am. J. Human Genetics 1103.) Finally, Mueller cited a letter to the journal Nature that he coauthored in response to a 1994 article that proclaimed the controversy over DNA evidence to be over. (Lander

---

9 Mueller also testified for the defense in *Soto*, presenting the same arguments against the product rule as he did in this case. (*Soto*, *supra,* 21 Cal.4th at pp. 529-530.)

& Budowle, *DNA Fingerprinting Dispute Laid to Rest* (Oct. 27, 1994) 371 Nature 735 (hereafter Lander & Budowle).) The letter, which was signed by 27 university scientists (including Mueller), asserted that the effect of population subgroups on frequency calculations remained a continuing cause for concern. However, this letter was never published,[10] and Mueller could only confirm that two of the signers still held the same views.

With regard to use of the product rule in PCR analysis, Mueller claimed some published results were "beginning to be seen, at least in [his] mind" that contradicted the assumptions of allele independence. The two articles Mueller relied on for this opinion reached a contrary conclusion, however, finding that all of the PCR loci used in the present case satisfied Hardy-Weinberg and linkage equilibrium expectations. (Budowle, et al., *Validation and Population Studies of the Loci LDLR, GYPA, HBGG, D7S8 and Gc (PM Loci), and HLA-DQa Using a Multiplex Amplification and Typing Procedure* (1995) 40 J. Forensic Sciences 45 (hereafter Budowle, Lindsey); Hochmeister, et al., *Swiss Population Data on the Loci HLA-DQ, LDLR, GYPA, HBGG, D7S8, Gc and D1S80* (1994) 67 Forensic Science Internat. 175.) Nevertheless, Mueller claimed he found departures from independence at two loci when he examined the data underlying these studies. Mueller also criticized the PCR databases as being too small to permit testing of the Hardy-Weinberg and linkage equilibrium assumptions with sufficient statistical power. He named Donald Barry, a statistician at Duke University, as someone who agreed with this criticism, yet the defense offered no further evidence about Barry or any published scientific work supporting his point of view.

In short, Mueller disagreed with the 1996 NRC Report concerning use of the unmodified product rule. Instead, he advocated either the ceiling principle (as proposed

---

10   According to Mueller, the journal had a policy against publishing letters with multiple authors.

22

in the 1992 NRC Report) or a formula called the counting method.[11] Mueller also
contended that any statistical calculation should be modified by the testing laboratory's
rate of errors or "false positives." Thus, if testing showed a DNA profile match with an
expected frequency of 1 in millions, but the lab had a false positive "error rate" of 1 in
1,000, Mueller would report only the larger, laboratory error statistic. Again, Mueller
acknowledged that the 1996 NRC committee rejected this idea. He was not aware of any
errors committed by the DOJ in connection with the DNA testing in this case.

Relying on the 1994 Fung article concerning the size of the FBI's fixed bins,
Mueller observed the DOJ's fixed bins may also be too small to accommodate a match
window that can be up to 7.2 percent wide (i.e., the size of the evidence band, plus or
minus 3.6 percent). He contended the only solution to this sizing problem was to add the
frequencies of all bins overlapped by a match window—a procedure the 1992 NRC
report suggested but the 1996 report abandoned. (1996 NRC Rep., *supra,* at p. 20.)
Mueller acknowledged that the DOJ had followed all statistical computation procedures
outlined in the 1996 NRC Report.

On March 3, 1998, the trial court denied appellant's motion to exclude DNA
evidence. Relying largely on the 1996 NRC Report, the court found the unmodified
product rule had gained general acceptance in the scientific community, both for RFLP
and PCR analysis. The court rejected the defense contention that the probability
calculations must be modified by a laboratory error rate, reasoning "that issue is really
not an issue related to the science but related to the scientist. It seems that if a lab error
should occur, then none of the probabilities have any scientific basis . . . ." The court
further observed that it found Dr. Mueller's analysis to be biased and not entirely
credible. Finally, noting the defense had raised issues about the DOJ's laboratory

---

11   Mueller also proposed this counting rule in *People v. Soto*. The Supreme Court described
it as a " '1/database method.' " (*Soto, supra,* 21 Cal.4th at p. 530.) Essentially, "Mueller would
simply count how many people in the database matched the [DNA profile]. Assuming no match
in the database, the probability would be reported as a fraction equalling [sic] 1/the number of
samples in the database (modified by a confidence interval.)" (*Ibid.*)

procedures, the court stated: "no evidence was produced to show that there was any departure from the generally accepted procedures in the scientific community . . . ."

DISCUSSION

I.   Admissibility Of The DNA Evidence

In *Kelly*, *supra,* 17 Cal.3d 24, the Supreme Court established a three-part test for the admissibility of evidence derived from a new scientific technique, such as DNA profiling.[12] First, "the reliability of the method must be established, usually by expert testimony." (*Id.* at p. 30, italics omitted.) "Reliability" means the technique is " 'sufficiently established to have gained general acceptance in the particular field in which it belongs.' " (*Ibid*., italics omitted, quoting *Frye v. United States* (D.C. Cir. 1923) 293 Fed. 1013, 1014.) Second, "the witness furnishing such testimony must be properly qualified as an expert to give an opinion on the subject." (*Kelly,* at p. 30, italics omitted*.*) And, third, "the proponent of the evidence must demonstrate that correct scientific procedures were used in the particular case." (*Ibid*.; see also *Venegas*, *supra,* 18 Cal.4th at p. 78.)

A.   General Acceptance Of Unmodified Product Rule

Appellant raises two arguments on appeal that he characterizes as "prong-one" *Kelly* challenges. He contends the unmodified product rule lacks general acceptance in the scientific community for PCR analysis due to problems caused by population subgroups and the relatively small size of PCR databases. He also argues that the product rule, as applied to both RFLP and PCR testing, has not gained general acceptance because a controversy remains as to whether the rule should be modified to account for laboratory error rates.

" 'General acceptance' under *Kelly* means a consensus drawn from a typical cross-section of the relevant, qualified scientific community." (*People v. Leahy* (1994) 8 Cal.4th 587, 612 (*Leahy*).) "The *Kelly* test does not demand 'absolute unanimity of

views in the scientific community . . . . Rather, the test is met if use of the technique is supported by a clear majority of the members of the community.' " (*Venegas*, *supra,* 18 Cal.4th at p. 85, quoting *People v. Guerra* (1984) 37 Cal.3d 385, 418.) It is settled that the product rule, as a relatively new statistical methodology, is subject to "*Kelly* screening" to assure both its general acceptance and its correct application. (*Venegas,* at p. 84; *Soto*, *supra,* 21 Cal.4th at pp. 518-519.)

On appeal, " 'general acceptance' " is considered "a mixed question of law and fact subject to limited de novo review." (*People v. Reilly* (1987) 196 Cal.App.3d 1127, 1134.) Thus, "we review the trial court's determination with deference to any and all supportable findings of 'historical' fact or credibility, and then decide as a matter of law, based on those assumptions, whether there has been general acceptance." (*Id.* at p. 1135.) Ordinarily, an appellate court will confine its review under *Kelly* to evidence contained in the trial record, but the court may also consult decisions from other jurisdictions on the issue of whether a technique has met with consensus among scientists. (*Id.* at pp. 1134-1135; *People v. Brown* (1985) 40 Cal.3d 512, 533-535, reversed on another ground in *California v. Brown* (1987) 479 U.S. 538.)

1.   Use Of Product Rule In PCR Analysis

In *Soto, supra*, 21 Cal.4th 512, the Supreme Court soundly rejected one of appellant's original claims on appeal, i.e., that use of the unmodified product rule was not validated by general consensus within the scientific community. After a detailed summary of expert testimony presented at two *Kelly* hearings and at trial, *Soto* discussed the decision in *People v. Axell* (1991) 235 Cal.App.3d 836, which confirmed general scientific acceptance of the product rule, and this court's 1992 decision in *Barney*, *supra,* 8 Cal.App.4th 798, which concluded subsequent publications had undermined the rule's acceptance. (*Soto,* at pp. 526-537.) The court then reviewed significant developments after *Barney*, including: (1) a 1993 FBI publication of a worldwide study of VNTR

---

12   The scientific technique involved in *Kelly* was voiceprint analysis. (*Kelly*, *supra,* 17 Cal.3d at p. 29.)

frequency data, which concluded the unmodified product rule was reliable and free from error due to population substructuring (IA Federal Bur. Investigation, U.S. Dept. Justice, VNTR Population Data: A Worldwide Study (1993)); (2) a 1994 article in which Dr. Eric Lander, formerly a leading opponent of the product rule, concluded the rule offered "a reasonable best estimate" of random match probabilities (Lander & Budowle, *supra,* at pp. 737-738); (3) publication of the 1996 NRC Report, which reexamined the statistical issues and explicitly approved use of the product rule (1996 NRC Rep., *supra,* at pp. 2-4, 122); and (4) a collection of articles, authored largely by defense expert witnesses, which criticized the 1996 NRC Report but expressed no disagreement with the product rule (e.g., Lempert, *After the DNA Wars: Skirmishing with NRC II* (Summer 1997) 37 Jurimetrics J. 439). (*Soto*, at pp. 537-539.)

The Supreme Court then observed that a majority of other states "have concluded that the controversy over population substructuring and use of the unmodified product rule has been sufficiently resolved," and "extensive literature" had developed in peer-reviewed scientific journals to show that population substructuring does not significantly impact frequency estimates using the product rule. (*Soto*, *supra,* 21 Cal.4th at pp. 540-541.) The court therefore concluded: "It is clear from the evidence in the record, the clear weight of judicial authority, and the published scientific commentary, that the unmodified product rule, as used in the DNA forensic analysis in this case, has gained general acceptance in the relevant scientific community and therefore meets the *Kelly* standard for admissibility." (*Id.* at p. 541.)

Respondent reads this decision broadly as an endorsement of *all* applications of the product rule; however, appellant correctly points out that *Soto* concerned only RFLP analysis, not PCR. No challenge was ever raised or considered in *Soto* to use of the product rule with PCR databases. Moreover, the court discussed scientific articles that analyzed the independence of VNTR alleles, and it cited no scientific conclusions specific to PCR markers. (See *Soto*, *supra,* 21 Cal.4th at pp. 538-539.) Thus, while *Soto*'s discussion of the population substructure issue is informative, it does not settle the question with respect to PCR analysis. (See *San Diego Gas & Electric Co. v. Superior*

26

Court (1996) 13 Cal.4th 893, 943 ["Cases are not authority . . . for issues not raised and resolved."].)

Nor do we consider the appellate court decisions in *Morganti*, *supra,* 43 Cal.App.4th 643, and *People v. Wright* (1998) 62 Cal.App.4th 31, to be controlling because neither case involved a *Kelly* challenge to the product rule. The defendant in *Morganti* challenged PCR typing and matching methodology as well as PCR-based "statistical evidence" (*Morganti*, at p. 669), but the court had no occasion to consider the product rule because the PCR testing was done for only *one* gene, DQ-alpha. (*Id.* at p. 662.) Thus, the frequency of the defendant's DQ-alpha genotype (one in twenty-two Caucasians) was not multiplied by anything. (See *id.* at p. 669.) In *Wright*, the defendant apparently did not raise a challenge under *Kelly* to use of the product rule in calculating the frequency of his PCR profile. Instead, he complained this statistical analysis violated his right to due process—an argument the court rejected. (*People v. Wright*, *supra,* at pp. 43-44.) The *Wright* court did not address the question of the product rule's general acceptance under *Kelly*. (See *id.* at pp. 37-44.)

The 1996 NRC Report examined in detail the reliability of the product rule in PCR analysis. (1996 NRC Rep., *supra,* at pp. 116-120.) Although PCR alleles have not been researched as extensively as VNTRs, and though PCR population databases are smaller, the NRC found that studies have shown PCR systems exhibit just as much independence as seen in VNTRs. (*Id.* at pp. 35, 117.) The report cited two studies by Dr. Bruce Budowle, which found compliance with Hardy-Weinberg and linkage equilibrium principles at multiple PCR loci. (*Id.* at p. 117, citing Budowle, Lindsey, *supra,* 40 J. Forensic Sciences 45; Budowle, et al., *D1S80 Population Data in African Americans, Caucasians, Southeastern Hispanics, Southwestern Hispanics, and Orientals* (1995) 40 J. Forensic Sciences 38 (hereafter Budowle, Baechtel).) Moreover, newer data showed that any impact of population substructure on PCR frequencies was very small. (1996 NRC Rep., *supra,* at pp. 35, 119.) Thus, the NRC concluded that PCR-based systems "are ready to be used along with VNTRs" (*id.* at p. 119) and recommended that probability calculations be made using the product rule. (*Id.* at pp. 38, 122.) The NRC also

suggested the use of a slightly higher correction factor in PCR product rule calculations, to account for the fact that PCR population data have been less extensively studied than for VNTRs. (*Id*. at p. 122.)[13]

At the *Kelly* hearing, prosecution expert Charlotte Word testified she is familiar with various studies that have confirmed the independence of the PCR loci at issue in this case: DQ-alpha, polymarker and D1S80. Word knew of no published article disagreeing with the use of the product rule to calculate PCR profile frequencies, and she attested that this rule is commonly used throughout the forensic community in connection with PCR. DOJ criminalist Gary Sims gave similar testimony.

To demonstrate that a controversy exists on this issue, appellant points only to the testimony of his expert, Laurence Mueller, and an essay Mueller later published. (Mueller, *The DNA Typing Controversy and NRC II* in Statistics in Genetics (Halloran & Geisser edits., 1999) pp. 1-23.) Mueller acknowledges that all published studies have confirmed the independence of PCR markers; however, he claims he found "significant departures" from Hardy-Weinberg equilibrium when he pooled and reanalyzed the data from these studies. (*Id.* at p. 6.) However, appellant cites no peer-reviewed scientific study that supports this conclusion, and it is far from clear that Mueller's own work was subjected to rigorous peer review.[14] Mueller's criticisms of the product rule contradict the great weight of published scientific opinion, and they were implicitly rejected by the 1996 NRC Report.

---

[13] Because appellant does not challenge the DOJ's actual computations, and because defense expert Mueller testified that DOJ had followed all the procedures recommended in the 1996 NRC Report, we assume the DOJ applied the higher correction factor suggested.

[14] Though appellant claims Mueller's article appears in a "peer reviewed professional journal," the preface of the book states that it "contains refereed papers from participants of the first week of a six-week workshop on Statistics in the Health Sciences." (Statistics in Genetics (Halloran & Geisser edits, 1999) at p. vii.) Nothing appellant has submitted to the court in his Further Request for Taking Judicial Notice suggests that this publication is an ongoing, professional journal.

Dr. Mueller's lone dissent is not sufficient to generate a controversy where the remainder of the scientific community has reached consensus on use of the product rule in PCR analysis. The *Kelly* test "does not demand 'absolute unanimity of views in the scientific community . . . . Rather, the test is met if use of the technique is supported *by a clear majority* of the members of that community.' " (*Leahy*, *supra*, 8 Cal.4th at p. 612, quoting *People v. Guerra*, *supra*, 37 Cal.3d at p. 418, italics added by *Leahy*; see also *People v. Axell*, *supra*, 235 Cal.App.3d at p. 860 ["[T]he defense witnesses' testimony on the issue of general acceptance did not undermine the validity of the trial court's determination that forensic use of RFLP analysis is generally accepted in the relevant scientific community."].)[15]

Appellant complains the trial court could not have found that use of the product rule in PCR is generally accepted because the prosecution did not present expert testimony on this subject from a population geneticist. Dr. Charlotte Word, a molecular biologist, testified about application of the product rule in PCR analysis. Over defense objections as to her qualifications, the court allowed Word to testify about how the product rule works. She also testified—without objection—that the product rule is generally used throughout the forensic community in PCR testing and is not controversial in the scientific community. While a trial court's ruling on expert qualifications is entitled to substantial deference on appeal (*Kelly*, *supra,* 17 Cal.3d at p. 39), the court here did not expressly find Word qualified to give an opinion as to the product rule's reliability in PCR analysis, nor do we think such a ruling can be implied from the overruling of certain defense objections.

However, the court had ample evidence in addition to Word's testimony demonstrating the general scientific acceptance of the product rule as applied to PCR. The 1996 NRC Report, which was the subject of much testimony by all experts in this case, unequivocally endorses the product rule for PCR statistical calculations. (1996

---

15   Mueller was one of the defense witnesses whose testimony on general acceptance was rejected in *Axell*. (*People v. Axell*, *supra*, 235 Cal.App.3d at pp. 851-853.)

NRC Rep., *supra,* at pp. 116-122.) As the Supreme Court observed, regarding the NRC's 1992 recommendation of the modified ceiling principle in RFLP analysis, " 'courts have recognized that "the [NRC] is a distinguished cross section of the scientific community. . . . Thus, that committee's conclusion regarding the reliability of forensic DNA typing . . . and the proffer of a conservative method for calculating probability estimates can easily be equated with general acceptance of those methodologies in the relevant scientific community." [Citation.]' [Citation.]" (*Venegas*, *supra,* 18 Cal.4th at p. 89.) Though the NRC's recommendation has changed (from use of a ceiling principle to the unmodified product rule), the respect courts afford conclusions of this esteemed scientific body has not. (See, e.g., *Soto*, *supra,* 21 Cal.4th at pp. 539-541.) In addition, the trial court considered peer-reviewed published studies that validated use of the product rule in PCR analysis. (Budowle, Lindsey, *supra,* at pp. 48-53; Budowle, Baechtel, *supra,* at pp. 42-43.) " '[C]onsiderations of judicial economy' . . . permit a court to scrutinize 'published writings in scholarly treatises and journals' in lieu of live testimony." (*Leahy, supra*, 8 Cal.4th at p. 611, quoting *People v. Shirley* (1982) 31 Cal.3d 18, 55-56.)

　　　　Finally, as our Supreme Court observed with respect to RFLP (*Soto*, *supra,* 21 Cal.4th at p. 540), we note that several other jurisdictions have approved the admissibility of statistical calculations applying the unmodified product rule to PCR-based evidence. (See, e.g., *State v. Gore* (2001) 143 Wash.2d 288 [21 P.3d 262] [Washington] [rejecting Mueller's criticisms and approving product rule in PCR under Washington's *Frye* test]; *Smith v. State* (Ind. 1998) 702 N.E.2d 668 [Indiana]; *State v. Jackson* (1998) 255 Neb. 68 [582 N.W.2d 317] [Nebraska]; *People v. Pope* (1996) 284 Ill.App.3d 695 [672 N.E.2d 1321] [Illinois]; *Com. v. Rosier* (1997) 425 Mass. 807 [685 N.E.2d 739] [Massachusetts]; *State v. Dishon* (1997) 297 N.J.Super. 254 [687 A.2d 1074] [New Jersey]; *State v. Hoff* (Mo.Ct.App. 1995) 904 S.W.2d 56 [Missouri]; see also *U. S. v. Gaines* (S.D.Fla. 1997) 979 F.Supp. 1429; *U. S. v. Shea* (D.N.H. 1997) 957 F.Supp. 331; *U. S. v. Lowe, supra,* 954 F.Supp. 401.)

2. Modification To Account For Laboratory Error Rates

Appellant also claims the DNA evidence should have been excluded because the statistical probability calculations were not modified to take account of laboratory error rates. A laboratory may commit some mistake in sampling or testing that results in an erroneous identification of the suspect—i.e., a "false positive." According to defense expert Mueller, the chances of a laboratory making such a mistake range from "1 in hundreds to 1 in thousands," yet that laboratory may declare, based on product rule calculations, that the chances of a random multiple-loci match between the suspect's DNA and that of a sample are 1 in millions or billions. Because the probability of an erroneous identification of the suspect due to laboratory error is much greater than the probability of an erroneous identification due to the commonness of a certain profile, Mueller contends laboratory error rates should be "the dominant statistic for evaluating the weight of a match."[16] Mueller acknowledged that laboratories typically do not publish their "error rates," although they sometimes disclose their proficiency testing results in court cases.

In contrast, prosecution expert Charlotte Word disagreed with the notion that error rates should be considered, in part because the concept of a "rate" implies that errors are recurring at some definite interval. In her analysis, the past experience of a laboratory in other cases is irrelevant to the question of whether it reached a correct result in the current case. Dr. Adams also testified that past errors, or errors from other laboratories, are not relevant considerations. The trial court, essentially agreeing with these witnesses, sustained many objections from the prosecution to defense questions concerning error rates from other laboratories and past errors in DNA testing at the DOJ laboratory.

We first address the threshold issue of whether appellant's "laboratory error" argument raises a foundational issue under *Kelly*. Relying on language excerpted from

---

[16]   Mueller supported this opinion with an example of a hypothetical missile that, when fired, has only a 1 in 1 billion chance of missing its target. However, in 1 out of 5 tries the missile does not fire at all. The probability that the missile will not function correctly is therefore 1 in 5, or 20 percent.

People v. Cooper (1991) 53 Cal.3d 771, respondent asserts that the possibility of error should affect the weight of the DNA evidence, not its admissibility. In *Cooper*, the defendant challenged the admissibility of bloodstain analysis under all three prongs of *Kelly*. After addressing the testing method and qualifications of the examiner (Gregonis), the court stated: "In a related vein, defendant also criticizes the precise manner in which Gregonis performed the tests. '[T]he *Kelly/Frye* rule tests the fundamental validity of a new scientific methodology, not the degree of professionalism with which it is applied. [Citation.] Careless testing affects the weight of the evidence and not its admissibility, and must be attacked on cross-examination or by other expert testimony.' [Citation]." (*Id.* at p. 814.) Similarly, in *People v. Wright*, the defendant's challenge to PCR testing on the ground that "samples may have been contaminated or confused . . . [and] laboratory procedures should have been more rigorous or controlled" did not raise a true *Kelly* issue, but simply affected the weight of the evidence. (*People v. Wright*, *supra,* 62 Cal.App.4th at p. 41.)

Once again, however, our state's precedents have not squarely addressed appellant's argument. Both *Wright* and *Cooper* concerned claims that testing errors occurred *in a particular defendant's case*. Here, appellant's only expert offered no opinions about the actual testing performed in this case and conceded he was not qualified to assess the quality of the forensic work. Rather than focusing on possible errors the DOJ may have committed in his case, appellant raises a more general issue: *whether calculations of the statistical significance of a DNA match should factor in or otherwise consider laboratory error rates*. This argument, like that against the product rule, essentially challenges the scientific validity of the DOJ's statistical methodology. Hence, we conclude it is properly considered as an issue of admissibility under *Kelly*.

The next question is whether it is a generally accepted practice in the scientific

community to calculate random match probabilities, in RFLP or PCR analysis, without factoring in a laboratory error rate.[17] The record before us suggests that it is.

In a section titled "Should an Error Rate Be Included in Calculations?" (1996 NRC Rep., *supra,* at pp. 85-87), the 1996 NRC Report listed four reasons why laboratory error should not be combined with random match probability calculations. First, the relevant statistic is not a general error rate for the testing laboratory, or laboratories in general, but whether the laboratory has committed an error in this particular case. But the risk of error in a particular case depends on many variables, and no simple equation exists to translate them into a probability statistic. (*Id.* at pp. 85-86.) Second, a testing laboratory would have to undergo an unrealistically large number of proficiency tests to allow the estimation of a statistically valid probability of error. (*Id.* at p. 86.) Third, although it might be possible to generate a probability statistic by pooling data from the proficiency tests of several laboratories, producing an " 'industry-wide' " error rate, this statistic would unfairly penalize better laboratories. (*Ibid.*) Fourth, an error rate estimated by a laboratory's historical performance on proficiency tests will almost certainly be too high, since errors will be investigated and corrected after they are discovered, and thus errors committed in the past are not likely to recur. (*Ibid.*) The committee concluded: "[W]e believe that a calculation that combines error rates with match probabilities is inappropriate. The risk of error is properly considered case by case, taking into account the record of the laboratory performing the tests, the extent of redundancy, and the overall quality of the results." (*Id.* at p. 87.) Moreover, a suspect's "best insurance" against the possibility of a false match due to laboratory error is the opportunity to have testing repeated at another facility. The committee therefore advised investigative agencies to retain samples for retesting whenever feasible. (*Ibid.*)

---

17   Appellant does not specify whether an error rate specific to the testing laboratory should be used, or whether probability calculations should consider an " 'industry-wide' " error rate. Because we conclude no mathematical modification for error rate is required under prevailing scientific opinion, we do not consider the different consequences such error rates might entail.

The first NRC report reached a similar conclusion. "While the Committee . . . noted that early in the application of DNA typing, nonblind proficiency studies suggested a high rate of false positives, the Committee said that '[c]oincidental identity and laboratory error are different phenomena, so the two cannot and should not be combined in a single estimate.' [1992 Rep., *supra,* at p. 88.] The Committee suggested, though, that error rates should be told to the jury. [*Id*. at p. 89.]" (*State v. Copeland* (1996) 130 Wash.2d 244, 270-271 [922 P.2d 1304, 1320], fn. omitted.)

Relying heavily on opinions of Jonathon Koehler and a "troika" of articles in the summer 1997 issue of the journal Jurimetrics, appellant claims these recommendations remain controversial. But these authors do not appear to represent the views of the *relevant, qualified scientific community*. (See *Leahy, supra*, 8 Cal.4th at p. 612.) Koehler is an associate professor of behavioral decision making at the Graduate School of Business and Law School at the University of Texas at Austin (Koehler, *Why DNA Likelihood Ratios Should Account for Error (Even When A National Research Council Report Says They Should Not)* (Summer 1997) 37 Jurimetrics 425, fn. *) William Thompson and Richard Lempert, two additional authors on whom appellant relies, are also not biological scientists, or statisticians.[18] The opinions of legal scholars and social scientists simply do not carry as much weight as the considered conclusions reached by the NRC, a body composed of " ' "a distinguished cross section of the scientific community." ' " (*Venegas*, *supra,* 18 Cal.4th at p. 89; see *People v. Shirley*, *supra*, 31 Cal.3d at p. 56, fn. 34 [according little weight to law review articles in general acceptance analysis].)[19] In assessing the opinion of the scientific community on a topic, " 'a court is

---

18   Thompson is a professor of criminology, law and society, and Lempert is a professor of law and sociology. (Thompson, *Accepting Lower Standards: The National Research Council's Second Report on Forensic DNA Evidence* (Summer 1997) 37 Judicature 405, fn. *; Lempert, *After the DNA Wars: Skirmishing with NRC II* (Summer 1997) 37 Judicature 439, fn. *.)

19   The Supreme Court recently observed that contributors to the issue of Judicature upon which appellant relies are " 'prolific commentators of DNA evidence' [citation], most of whom 'have served as expert witnesses for defendants' [citation]. Moreover, the articles were selected

bound to let scientists speak for themselves.' " (*Ibid.*, quoting *Kelly*, *supra,* 17 Cal.3d at pp. 39-40.)

As evidence of a controversy, appellant also cites the unpublished letter that Dr. Mueller and 26 other signatories submitted to the scientific journal Nature in response to a 1994 article by Drs. Lander and Budowle. The letter asserted that blind proficiency testing should be conducted to produce accurate estimates of laboratory error rates, and it advocated the consideration of error rates in connection with random match calculations. However, this unpublished letter predated the 1996 NRC Report, and appellant produced no evidence to show that any scientists other than his expert Mueller, and possibly two other signers, continued to hold the same views.

Appellant offers several detailed arguments criticizing the DOJ's calculation of match probabilities without consideration of a laboratory error rate. However, "our duty is *not* to decide whether [a methodology] is reliable as a matter of 'scientific fact,' but simply whether it is generally accepted as reliable by the relevant scientific community." (*People v. Shirley*, *supra*, 31 Cal.3d at p. 55.) Because appellant has not presented persuasive evidence of an ongoing controversy in the scientific community, we conclude that the NRC's recommendation is generally accepted, and DNA probability calculations need not be modified to account for a laboratory error rate. Our holding is in accord with the few published decisions that have addressed the issue. (See *State v. Copeland*, *supra*, 922 P.2d at pp. 1319-1320 [relying on 1992 NRC Report to conclude "laboratory error rate is not appropriately a part of the probability calculations"]; cf. *U. S. v. Shea*, *supra,* 957 F.Supp. at pp. 344-345 [finding evidence of random match probability was not unfairly prejudicial even though it was not modified by an estimated laboratory error rate].)

Our decision addresses only the necessity of reporting a "summary statistic," i.e., a probability statistic derived when a "laboratory error rate" is combined with a DNA

---

by a process that tended to give preference to criticism, rather than approval, of the 1996 NRC Report." (*Soto*, *supra,* 21 Cal.4th at p. 539.)

profile's random match probability. We have concluded such a combination is not

sanctioned by the weight of scientific opinion. However, we express no opinion on

whether a jury can or should receive evidence concerning rates of laboratory error

separate and apart from the random match probability statistic. Moreover, it should be

clear that our decision does not preclude cross-examination on the subject of laboratory

error, or the possibility that such errors were committed in a particular case. In general,

criticisms about the quality of DNA testing go to the weight of the evidence (*People v.*

Wright, *supra,* 62 Cal.App.4th at p. 41) and hence are appropriate topics for cross-

examination.[20]

B.   Use Of Correct Scientific Procedures With Fixed Bins

Appellant also contends the DOJ's use of undersized fixed bins fails to comport

with correct scientific procedures. "Unlike the independent appellate review of a

determination of general scientific acceptance under *Kelly*'s first prong, review of a third-

prong determination on the use of correct scientific procedures in a particular case

requires deference to the determinations of the trial court." (*Venegas*, *supra,* 18 Cal.4th

at p. 91.) Therefore, we review trial court findings on the use of correct scientific

procedures for abuse of discretion only. (*Id.* at pp. 91, 93; *People v. Ashmus* (1991) 54

Cal.3d 932, 971.) Although the trial court here made no express ruling on the fixed bin

issue, a finding in the prosecution's favor is fairly implied from the court's determination

that "no evidence was produced to show that there was any departure from the generally

accepted procedures in the scientific community . . . ."

Raising a similar argument to the one he presented against floating bins in *People*

v. Venegas, *supra,* 18 Cal.4th at pages 90-91, defense expert Mueller testified that the

DOJ uses improperly sized fixed bins in determining the probability of a random match

---

[20]   In fact, that is exactly what happened in this case. Appellant cross-examined criminalist
Sims about possible contamination of DNA samples, a mistake in one test, and a possible sizing
error on bands at one VNTR locus. In addition, defense expert Mueller estimated that DNA
laboratories have error rates ranging from 1 in 700 to 1 in 7000, and he offered the jury
recalculated probability figures using various lab error estimates.

in RFLP analysis.**21** The DOJ creates an uncertainty interval of plus or minus 1.8 percent

around both the evidence band and the suspect band on an autorad. If the windows

surrounding these two bands overlap, even slightly, the DOJ will declare a match. Thus,

Mueller concludes, the match criteria may be as wide as plus or minus 3.6 percent, or a

total of 7.2 percent. When the DOJ then consults the FBI's fixed bin system to determine

the population frequency of the match, Mueller contends the fixed bin must be at least as

wide as the match criteria, i.e., at least 7.2 percent wide, or else the population frequency

figure yielded by the database will be too small. (Logically, because a larger bin

encompasses a greater range of base-pair sizes, it is likely to incorporate more bands and

thus have a higher population frequency value.) Therefore, Mueller concludes, the DOJ

underestimates the probability of a random match every time a match falls within a fixed

bin smaller than 7.2 percent.

Notably, Mueller's testimony on this point at the *Kelly* hearing was purely

theoretical. Mueller did not determine whether any such bin-sizing errors actually

occurred in the DOJ's RFLP analyses in this case. Quite possibly, they did not. Mueller

testified that the DOJ uses the fixed bin system developed by the FBI, but only four of the

FBI's 31 fixed bins are smaller than 7.2 percent. (See Fung, *supra,* at p. 114 [FBI fixed

bin table].)

Nevertheless, appellant argues that reversal is necessary because Mueller's

uncontradicted testimony shows the DOJ's fixed bin method is procedurally unsound,

just as the FBI's floating bin protocol was found to be defective in *People v. Venegas*.

We disagree.

In *Venegas*, *supra,* 18 Cal.4th 47, the Supreme Court addressed the narrow

question of whether the FBI's use of floating bins comported with generally accepted

scientific procedures. Whereas a fixed bin describes the population frequency for a

---

21   Because PCR analysis isolates and identifies the alleles themselves, it does not involve
the matching and binning procedures required in RFLP testing. (1996 NRC Rep., *supra,* at
p. 70.)

preexisting range of VNTR band sizes, a floating bin is constructed anew around every match. (*Id.* at pp. 64-65.) A floating bin is *defined* as the range of base-pair sizes around the evidence band equal to the match window. (1996 NRC Rep., *supra,* at p. 143 ["[T]he floating bin is always the same [size] as the match window."].) Given the FBI's uncertainty window of plus or minus 2.5 percent, the NRC defines the "match window," for purposes of binning, as "the evidence measurement with 5% of its value added and subtracted." (*Id.* at p. 20.) This means that, under the floating bin method, population frequency is determined for each allele by querying a database for frequency data on all bands covering a 10 percent range in size around the evidence band. Despite these NRC guidelines, in *Venegas* the FBI constructed floating bins of only plus or minus 2.5 percent. (*Venegas*, *supra,* at pp. 72, 90.) Thus, the FBI's floating bins were only 5 percent wide instead of the recommended 10 percent. Because uncontradicted testimony established that the FBI failed to follow accepted scientific procedures when it constructed floating bins of half the recommended size, the Supreme Court concluded the DNA evidence should have been excluded. (*Id.* at p. 92-93.)

The fixed bin method employed in this case differs in significant respects from the procedure at issue in *Venegas*. "Fixed bins . . . compartmentalize the entire spectrum of VNTR base-pair sizes likely to appear as bands on an autorad. . . . A separate fixed-bin table is compiled for each locus in each database." (*Venegas*, *supra,* 18 Cal.4th at p. 65.) Using fixed bins, an analyst determines the population frequency of a match at a certain locus by comparing the match window with the fixed bin table. Again, the NRC defines the match window, based on FBI criteria, as the range of sizes 5 percent above and 5 percent below the evidence band. (1996 NRC Rep., *supra,* at p. 20.) If this range of values happens to lie within a single fixed bin, the frequency of that bin is used to calculate the probability of a random match. However, if the match window overlaps two (or more) fixed bins, the NRC advises that the bin with the highest frequency should be used in the calculations. (*Ibid.*) The 1992 NRC Report recommended using the sum of all overlapped bins, but the 1996 Committee abandoned this approach because empirical studies showed it was too conservative. (*Id.* at pp. 20, 143-144.)

No evidence produced at the *Kelly* hearing, or at trial, suggests the DOJ failed to follow these procedures. Gary Sims testified the DOJ performed its fixed bin calculations according to the method currently recommended by the NRC. Moreover, defense expert Mueller's criticism of fixed bins was entirely generic. He faulted the DOJ only for using the FBI's fixed bins and, in the event of overlap, not following the 1992 NRC procedure of summing the bin frequencies. Mueller agreed, though, that the DOJ followed the NRC's 1996 procedures in performing the product rule calculations in this case.

Appellant's true complaint, it would seem, is with the validity of the fixed bin calculations recommended in the 1996 NRC Report—i.e., when a match window overlaps two bins, the bin with the highest frequency (and not the sum of both bins' frequencies) should be used to calculate random match probability. (1996 NRC Rep., *supra,* at pp. 20, 143-144.) But appellant did not challenge the *general acceptance* of this fixed bin procedure below, and the record is not sufficiently developed to permit us to address it.

Moreover, in his zeal to liken the procedures in this case to the error in *Venegas*, appellant ignores key differences between fixed and floating bins. Appellant argues that fixed bins must be at least as large, percentage-wise, as the match window, or else they will underestimate population frequency. However, as Dr. Adams observed when presented with this theory on cross-examination, comparing the percentage size of a match window with the percentage size of a fixed bin is like comparing "chalk and cheese." The relevant question is not the percentage size of fixed bins, but what to do in the event a match window overlaps multiple bins.[22] The NRC has resolved this problem

_____

[22] A simple example demonstrates this point. Assume the DOJ declares a match at the VNTR locus D2S44, and the evidence band measures 1500 bp. A match window of plus or minus 3.6 percent runs from 1446 bp to 1554 bp (since 3.6 percent of 1500 is 54). This range happens to overlap bins 8 and 9 in the FBI's fixed bin system. Bin 8 encompasses bands sized 1,353-1,507 bp, and bin 9 includes bands sized 1,508-1,637 bp. (1996 NRC Rep., *supra,* at p. 20 [bin tables for United States Caucasians]; Fung, *supra,* at p. 114 [bin table for Hong Kong Chinese].) According to the only scientific article appellant cites on this issue, FBI's fixed bins 8

by recommending that calculations be made using the bin with the highest population frequency, and there is no indication the DOJ departed from this recommended procedure.

In short, the trial court did not abuse its discretion in finding the DOJ used correct scientific procedures in calculating random match frequencies using fixed bins.

II.   Sufficiency Of Evidence Of Sexual Battery

Appellant next contends insufficient evidence supports his conviction of sexual battery in connection with the Linda H. case because he did not "cause" the victim to masturbate him. After appellant forced Linda to perform oral copulation, he turned her onto her stomach, pulled down her pants and underwear and attempted to penetrate her with his penis. In order to avoid being raped, Linda reached down and manually masturbated appellant until he ejaculated. Appellant now claims this act of masturbation did not constitute a sexual battery because it was "entirely [the victim's] idea." This argument merits little discussion.

A sexual battery occurs when "[a]ny person who, for the purpose of sexual arousal, sexual gratification, or sexual abuse, causes another, against that person's will while that person is unlawfully restrained . . . to masturbate or touch an intimate part" of the accused or some other person. (Pen. Code, § 243.4, subd. (c).)[23] In interpreting this statute, we give the words their ordinary, commonsense meanings. (*People v. Prevost* (1998) 60 Cal.App.4th 1382, 1391-1392.)

The parties disagree over the meaning of "cause," used as a verb. Appellant asserts the word "cause" must be limited to mean, for purposes of section 243.4, the

---

and 9 are both *larger* than 7.2 percent. (Fung, *supra,* at p. 114 [bin 8 is 10.8 percent; bin 9 is 8.2 percent].) Even though both fixed bins are theoretically large enough under appellant's view, the match window still overlaps multiple bins because the evidence band happens to fall very close to the boundary between the two fixed bins. Thus, even if all fixed bins were made substantially wider than an agency's match window, the problem of overlapping would still arise at the boundaries between fixed bins. This aspect of fixed bins marks a fundamental difference from the floating bins discussed in *Venegas*.

[23]   All statutory references are to the Penal Code unless otherwise specified.

effecting or bringing about of an action "by command, authority, or force." (Webster's Collegiate Dict. (2001) <http://www.m-w.com/cgi-bin/dictionary> [as of July 26, 2001] [second definition].) But appellant's definition is narrower than the ordinary meaning of the word. The verb "cause" means, more broadly, "[t]o be the cause of; to effect, bring about, produce, induce, [or] make." (Oxford English Dict. (2d ed. CD-ROM 1994); see also Webster's Collegiate Dict., *supra,* <http://www.m-w.com/cgi-bin/dictionary> [first definition: "to serve as a cause or occasion of"].) Appellant was molesting Linda by force, and she masturbated him only as way to avoid an imminent rape. Clearly, appellant's demand for sexual gratification "induced" or "brought about" or "occasioned" the masturbation. Moreover, even if we were to read into section 243.4 an additional requirement of "command, authority, or force," we would find such a requirement easily satisfied under the facts of this case. Appellant had physically restrained Linda and was attempting to rape her. She obviously did not consent to the encounter, and her touching of appellant was motivated solely by the desire to avoid suffering a more egregious violation. The evidence was sufficient to support the charge of sexual battery.

III.   Absence Of Instruction On Lesser Included Crimes

Appellant was charged with robbery of Linda H., Carol B. and Janice B. and with attempted robbery of Debra E. Appellant did not request a jury instruction as to the elements of theft, which is a lesser included offense of the crime robbery. (*People v. Turner* (1990) 50 Cal.3d 668, 690.) He now argues the trial court should have instructed the jury sua sponte on the lesser included offenses of theft and attempted theft, and its failure to do so requires reversal.

"California law requires a trial court, sua sponte, to instruct fully on all lesser necessarily included offenses supported by the evidence." (*People v. Breverman* (1998) 19 Cal.4th 142, 148-149 (*Breverman*).) The trial court has no obligation to instruct on theories not supported, or only weakly supported by the evidence; however, "instructions are required whenever evidence that the defendant is guilty only of the lesser offense is 'substantial enough to merit consideration' by the jury. [Citations.] 'Substantial

evidence' in this context is ' "evidence from which a jury composed of reasonable [persons] could . . . conclude[]" ' that the lesser offense, but not the greater, was committed. [Citations.]" (*Id*. at p. 162.)

Robbery is defined as the taking of personal property from another's person, or in his immediate presence, against his will, and accomplished by force or fear. (§ 211.) Theft is a lesser included offense of robbery that does not include the additional element of force or fear. (*People v. Turner, supra,* 50 Cal.3d at p. 690.)

Appellant asserts that in each of the sexual assault cases, the jury heard sufficient evidence from which it could have concluded appellant was not guilty of robbery or attempted robbery, but only of the lesser crimes of theft or attempted theft. Respondent, on the other hand, contends there was *no* evidence that any of the offenses were less than robbery or attempted robbery, and thus the court had no sua sponte obligation to instruct on lesser crimes. (See *People v. Wickersham* (1982) 32 Cal.3d 307, 323-324, disapproved on another ground in *People v. Barton* (1995) 12 Cal.4th 186, 200-201.) We agree with respondent as to the three robbery charges, but we determine that substantial evidence was presented in the Debra E. case to support a conviction for the lesser included offense of attempted theft, and the trial court should have given this instruction.

The pertinent facts are very similar in the Linda H., Carol B. and Janice B. cases. Appellant entered these victims' bedrooms in the early morning, woke them, sexually assaulted them, then ushered them into the shower and told them to stay there while he searched the house. The women cooperated, and they later discovered some of their property had been taken. According to appellant, these facts do not support robbery because no property was taken from the victims' persons or in their actual presence. "If there is substantial evidence that an element of an offense is missing, the court must instruct sua sponte on the lesser included offense. [Citations.]" (*People v. Holt* (1997) 15 Cal.4th 619, 675.) However, the crime of robbery requires only the taking of an object from the "immediate presence" of the victim, which has been defined as the zone " 'within which the victim could reasonably be expected to exercise some physical control over his property.' " (*Ibid.,* quoting *People v. Webster* (1991) 54 Cal.3d 411,

440.) Areas of the victims' apartments outside the bathroom were areas over which they had control before appellant coerced them into the shower. (See *People v. Holt*, at p. 675 [property taken from kitchen, while victim lay in the living room, satisfied "immediate presence" requirement].)

Appellant also argues the evidence could have supported a finding that negated the "force or fear" element of robbery in these three incidents. In all three cases, the victims first learned of appellant's presence when they woke to find him in the bedroom. Appellant claims he could have searched through the women's apartments, choosing the items he intended to steal before he ever awakened the occupants. But, even assuming such facts point to theft and not robbery, the jury heard no evidence to suggest that this hypothetical series of events actually occurred. Rather, the evidence clearly showed that appellant looked through the victims' homes for valuable property while he kept them in the shower with threats of physical injury. (See *People v. Brown* (1989) 212 Cal.App.3d 1409, 1418 ["The threat to inflict injury is, alone, sufficient to satisfy the statutory requirement [of force or fear] . . . ."], disapproved on another ground in *People v. Hayes* (1990) 52 Cal.3d 577, 628, fn. 10.) The mere possibility that a jury could have speculated about possible movement of property before the assaults was not supported by any evidence, and thus the trial court did not err in failing to sua sponte instruct on the lesser included offense of theft.

The Debra E. case poses a more difficult question, however. Debra also woke to find appellant in her bedroom, but unlike the other victims she refused to stay quiet. She struggled and, in the process, suffered a brutal physical assault. Appellant fled the apartment in a rush at the sound of police sirens. Although nothing of Debra's was stolen, a jewelry box had been moved from the bathroom to the living room, and a ring and gold necklace belonging to Debra's roommate were later discovered to be missing. These missing items were never recovered.

Due to appellant's immediate flight, it is clear he moved the jewelry found in Debra's living room *before* the assault. This is not a case of a perpetrator who, having peacefully acquired property, uses force to retain or escape with it. (See *People v.*

Winkler (1986) 178 Cal.App.3d 750, 756.) Rather, the evidence suggests appellant had the opportunity to leave peacefully with the property he gathered from Debra's apartment, but instead he chose to wake Debra and assault her. Respondent offers no indication that the assault on Debra was in any way motivated by an intent to steal her property. To support a charge of robbery, "[t]he wrongful intent and the act of force or fear 'must concur in the sense that the act must be motivated by the intent.' [Citations.]" (*People v. Marshall* (1997) 15 Cal.4th 1, 34.) There is no evidence of such a concurrence of act and intent in the Debra E. incident. (See *People v. Kelley* (1990) 220 Cal.App.3d 1358, 1368-1369 [the taking of property from a sleeping or unconscious victim is theft, not robbery, due to absence of force or fear].)

In an attempt to tie the assault to the movement of property, respondent focuses on the fact that appellant did not take any property away from the residence before he assaulted Debra. If there were evidence of such a taking, the facts would have demonstrated a completed theft, and required such an instruction. However, the evidence actually presented was consistent with an attempted theft, since it was undisputed the perpetrator moved property with the intent of stealing it. Likewise, we reject respondent's invitation to speculate that, had she not resisted, the Debra E. encounter would have ended with the same victim-in-shower robbery as occurred in the other sexual assault cases. This "bootstrapping" argument is clearly insufficient to support respondent's assertion that the evidence *only* supported a charge of attempted robbery.

Based on the evidence in the Debra E. case, a reasonable jury could conclude appellant committed the lesser offense of attempted theft but not the greater offense of attempted robbery. The trial court therefore had a duty to instruct the jury, sua sponte, on the lesser included crime, and its failure to do so was error. (*Breverman, supra,* 19 Cal.4th at p. 162.)

To determine whether this error was prejudicial, we must consider whether, " 'after an examination of the entire cause, including the evidence' (Cal. Const., art. VI, § 13), it appears 'reasonably probable' the defendant would have obtained a more favorable outcome had the error not occurred ([*People v.*] *Watson* [(1956)] 46 Cal.2d

818, 836)." (*Breverman, supra,* 19 Cal.4th at p. 178.) The question is not what a jury *could* have done, but what a jury would *likely* have done if properly instructed. (*Id.* at p. 177.)

Based on the undisputed evidence in the Debra E. case, it is reasonably probable a jury instructed on attempted theft would have convicted appellant of this lesser crime, and not the greater offense of attempted robbery. The assailant never said anything to Debra about taking her property; indeed, she believed he intended to rape or kill her. During the course of their struggle, Debra did not notice that the attacker held anything in his hands. About a week after the incident, Debra and her roommate found a jewelry box, which they had believed stolen, hidden behind their couch. The evidence indicates that, at most, appellant moved the jewelry box and may have taken a ring and necklace from the apartment (although police did not recover these items in their search of the Clifton warehouse). But, since Debra testified that her attacker immediately ran away when he heard police sirens, he could only have disturbed this property *before* he woke Debra and brutally assaulted her.

Because the prosecution did not demonstrate a nexus between the movement of property and the subsequent assault, the evidence in support of attempted robbery was weak, whereas the circumstantial evidence of attempted theft was comparatively strong. (See *Breverman, supra,* 19 Cal.4th at p. 177.) Under these facts, we conclude there is a reasonable probability that an instruction on the lesser included offense of theft would have resulted in a more favorable outcome for appellant. This error does not require total reversal of appellant's conviction on the attempted robbery charge, however. The appropriate remedy is a modification of the judgment that reduces appellant's conviction, and the appropriate sentence, from attempted robbery to attempted theft. (*People v. Kelley*, *supra*, 220 Cal.App.3d at p. 1370; *People v. Alexander* (1983) 140 Cal.App.3d 647, 666 ["An appellate court is not restricted to the remedies of affirming or reversing a judgment. Where the prejudicial error goes only to the degree of the offense for which

the defendant was convicted, the appellate court may reduce the conviction to a lesser degree and affirm the judgment as modified . . . ."].)[24]

IV.   Sentencing Error

Appellant claims the trial court erred in calculating his sentence with respect to the Debra E. incident.

The jury convicted appellant of five charges in the Debra E. case: burglary, attempted robbery, assault with great bodily injury force, battery with serious bodily injury, and false imprisonment by violence.[25] Because the burglary and attempted robbery charges addressed the same course of conduct, the court stayed the imposition of sentence for attempted robbery. For the same reason, the court stayed sentence on the battery count in favor of imposing sentence on the charge of assault with great bodily injury force. The court also stayed any sentence on the false imprisonment charge, because this offense was simply the means by which appellant committed the other offenses. The court sentenced appellant to serve an aggravated term of six years for the burglary charge and one year for the assault.[26] Based on the jury's finding that appellant inflicted great bodily injury in connection with these crimes, the court added three years to the burglary sentence and one year to the assault sentence—both as enhancements for great bodily injury (§ 12022.7). Appellant complains the imposition of these two great bodily injury enhancements for a single course of conduct was error.

Section 654 provides, in part: "An act or omission that is punishable in different ways by different provisions of law shall be punished under the provision that provides for the longest potential term of imprisonment, but in no case shall the act or omission be punished under more than one provision." (§ 654, subd. (a).) Appellate courts have

---

[24]   In light of our reversal on this ground, we do not address appellant's challenge to the sufficiency of evidence supporting the attempted robbery conviction.

[25]   The jury acquitted on a charge of assault with intent to rape.

[26]   The court imposed a term of four years on the assault charge but stayed three years of this sentence pursuant to section 1170.1.

disagreed about whether section 654 applies to sentence enhancements. Some courts have considered enhancements exempt from section 654 because they do not define a crime or offense but relate only to the penalty to be imposed (e.g., *People v. Boerner* (1981) 120 Cal.App.3d 506, 511), whereas other courts reason that section 654 applies to enhancements, just like offenses, because the statute proscribes all attempts to impose multiple punishment for the same act (e.g., *People v. Moringlane* (1982) 127 Cal.App.3d 811, 817). (See *People v. Arndt* (1999) 76 Cal.App.4th 387, 394-395 [collecting cases].) While recognizing this disagreement, the Supreme Court has not yet resolved it. (*Ibid.*)

Respondent urges us to follow the *People v. Boerner* line of cases and hold that section 654 does not apply to sentence enhancements. We decline to do so. Recent appellate decisions from other districts have applied section 654 to enhancements. (See, e.g., *People v. Arndt*, *supra*, 76 Cal.App.4th at pp. 394-396; *People v. Price* (1992) 4 Cal.App.4th 1272, 1277.) Indeed, the same court that originally decided *Boerner* later observed, " 'it is now well accepted that section 654 applies to enhancements . . . .' " (*People v. Ross* (1994) 28 Cal.App.4th 1151, 1157, fn. 9, quoting *People v. Dobson* (1988) 205 Cal.App.3d 496, 501.)

Moreover, though it did not directly address the question, the Supreme Court's decision in *People v. Coronado* (1995) 12 Cal.4th 145, 157 suggests section 654 does apply to some types of enhancements. *Coronado* held that section 654 does not prohibit the use of a prior felony conviction both to elevate the current felony conviction and to enhance the sentence under section 667.5. In reaching this conclusion, the court distinguished between "two types of sentence enhancements: (1) those which go to the nature of the offender; and (2) those which go to the nature of the offense [Citation.]" (*Coronado,* at p. 156.) Whereas enhancements such as section 667.5 "are attributable to the *defendant's status* as a repeat offender[] [citations]" (*id*. at pp. 156-157), the court observed that "the second category of enhancements, which are exemplified by those authorized under sections 12022.5 [use of firearm] and 12022.7 [great bodily injury], arise from the *circumstances of the crime* and typically focus on what the defendant did when the current offense was committed. [Citation.]" (*Id.* at pp. 156-157, fn. omitted.)

Although *Coronado* does not reach the question of whether section 654 applies to this second category of enhancements (*see id*. at p. 157), the distinction it draws between types of enhancements is significant. Multiple enhancements for the same criminal conduct run directly counter to section 654's rule against multiple punishment in a way offender-status-based enhancements do not. (See *People v. Arndt*, *supra*, 76 Cal.App.4th at pp. 395-396 [concluding from *Coronado* analysis that section 654 applies to bodily injury enhancements].)

Applying section 654 to this case, we conclude the imposition of two great bodily injury enhancements in connection with the Debra E. assault was error. "The 'cases which do apply . . . section 654 to enhancements have limited the number of enhancements applied to a single conviction, when there was a single act committed against a single victim.' [Citations.]" (*People v. Arndt*, *supra*, 76 Cal.App.4th at p. 396; see also *People v. Akins* (1997) 56 Cal.App.4th 331, 338 ["[N]early all of the cases that have applied section 654 to limit enhancements have done so in the context of a single act committed against a single victim."].)

Appellant was convicted of both burglary and assault in the Debra E. case, and he does not challenge his separate punishments for these convictions under section 654. Respondent argues the record supports two bodily injury enhancements, just as it supports the two sentences for burglary and assault, because appellant harbored multiple criminal objectives that can be punished independently. (See *People v. Perez* (1979) 23 Cal.3d 545, 551; *People v. Akins*, *supra*, 56 Cal.App.4th at p. 339.) However respondent directs us to no precedent approving of multiple sentence enhancements for a single assault against a single victim, even though the defendant committed additional crimes against that victim. On the contrary, the court in *People v. Moringlane*, *supra*, expressly held that "section 654 . . . prohibits the imposition of multiple enhancements for the single act of inflicting great bodily injury upon one person." (127 Cal.App.3d at p. 817; see also *People v. Alvarez* (1992) 9 Cal.App.4th 121, 127 ["[G]enerally only one enhancement for great bodily injury may be imposed where multiple offenses are committed against a single victim on a single occasion"]; *People v. Culton* (1979) 92

Cal.App.3d 113, 117 ["The Attorney General has properly conceded that only one enhancement for great bodily injury is possible"].)

In the absence of any evidence making the assault of Debra E. divisible (see, e.g., *People v. Dominick* (1986) 182 Cal.App.3d 1174, 1210 [permitting two enhancements where defendant committed two separate assaults on a single victim]), the trial court should not have imposed two great bodily injury enhancements under section 12022.7.

DISPOSITION

The judgment is modified to reduce appellant's conviction from attempted robbery to attempted theft and to stay the one-year sentence enhancement for great bodily injury applied to the assault conviction in the Debra E. case (count 25). In all other respects, the judgment is affirmed.

_____
Parrilli, J.

We concur:

_____
Corrigan, Acting P. J.

_____
Horner, J.*

---

* Judge of the Superior Court of Alameda County, assigned by the Chief Justice pursuant to article VI, section 6 of the California Constitution.

Trial Court: Marin County Superior Court

Trial Judge: Hon. William H. Stephens

Counsel for Appellant: William M. Robinson, under appointment by the Court of
                             Appeal

Counsel for Respondent: Bill Lockyer, Attorney General, David P. Druliner, Chief
                             Assistant Attorney General; Ronald A. Bass, Senior
                             Assistant Attorney General; Stan M. Helfman, Supervising
                             Deputy Attorney General; Enid A. Camps, Deputy Attorney
                             General; and Sharon G. Birenbaum, Deputy Attorney
                             General.